



The Grow Network

WHITE PAPER

Connecting Cognitive Science, Academic Standards, and Assessment Data to Accelerate Student Achievement

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Executive Summary

In this age of accountability, assessments, and state standards, student achievement is a clear and shared goal, but getting there has proven to be fraught with challenges. Focusing educational efforts on the most significant learning objectives, making sense of assessment data, and working to meet each student at the appropriate level of instruction are significant issues that require persistent attention and innovative solutions.

The Grow Network/McGraw Hill is utilizing two powerful proprietary tools to address these challenges and deliver on the promise of assessment to accelerate student achievement.

- 1 By identifying *cognitively important skills* whose mastery is fundamental to success on assessments and to the development of deeper knowledge, a proprietary standards framework connects cognitive science and standards, revealing a granular view of how students learn.
- 2 By transforming the broad overall performance levels and potentially misleading topic-level raw scores of assessment reports into *actionable topic performance levels*, a proprietary algorithm presents the opportunity to deliver appropriately leveled content to students based on assessment data.

These tools facilitate the production of individualized instructional materials that

- Focus attention on the most *instructionally relevant granular skills*
- Help teachers easily provide *differentiated instruction* in a group setting
- Provide students with *personalized instruction* that targets gaps in their knowledge and leads to accelerated achievement

The purpose of this white paper is to highlight how McGraw Hill's proprietary standards framework and data analysis algorithm work together to facilitate the development of unparalleled personalized curriculum that meets the tremendous challenges presented by this era of high-stakes assessments in K–12 education.

Introduction

This era of accountability, assessments, and state standards has radically altered the environment of K–12 education. Curricula and assessments are aligned to complex and diverse state standards, leading to the proliferation of state-specific curriculum materials, test prep materials, and intervention programs. For schools, the objective of high achievement across all students is clear. Less clear are the best practices for enabling teachers to most easily achieve educational progress for each student.

The Grow Network/McGraw Hill is a global leader and innovator in assessment reporting and individualized instruction. The Grow Network produces personalized print and online instructional materials using a proprietary standards framework that identifies the most instructionally relevant skills, and a proprietary data analysis algorithm that calculates student performance levels in each topic area within a subject, making deep connections among academic standards, assessment data, and curriculum. By focusing on the very granular skills that constitute standards and on the most appropriate level of instruction in each topic for each student, these tools offer an exceptional means of using assessment data to transform instruction and accelerate student achievement.

Challenges in the Disconnect Between Assessment and Instruction

Bridging the gap between the mandates of assessments and demonstrated educational progress demands advanced tools designed to meet a host of challenges. In order to address these challenges, we must

→ **Remove barriers between assessments and instruction**

School systems require tools that use student assessment data to drive sound instructional decision-making in the classroom. Leveraging assessments to facilitate individual student achievement requires the transformation of topic-level raw scores currently provided on assessment reports into meaningful information that can help guide the type of instruction appropriate for each student.

→ **Use data to individualize curricula**

To meet the needs of individual students, we must dive deeply into assessment reporting categories and state standards to better understand how students learn and what skills are most critical for cognitive development and future academic growth. To translate test scores into personalized curricula, we need a more precise definition of what students know and how they can best move to the next level of achievement.

→ **Focus on mastery**

Rather than “teach to the test,” we need instructional materials that both accelerate student achievement on assessments and deepen students’ underlying knowledge of core subjects. Students need to be actively engaged in learning, even as they prepare for high-stakes assessments. Teachers need instructional programs that allow for differentiated instruction of critical skills, with options for group and individual engagement at the appropriate level.

→ **Tightly align to state standards**

State standards come in all shapes and sizes. Some standards are represented in assessment reporting categories, while others are embedded within test questions without explicit scores being generated (e.g., problem-solving skills). While each standard cannot be afforded equal treatment in the curriculum, educators must know which standards, and even more significantly, which specific skills embodied within standards are central to student achievement.

Building a Framework for Success: Connecting Cognitive Science, Standards, and Assessment Data

The Grow Network and its experts have leveraged the latest in cognitive science research, the intelligent use of technology, and decades of experience in educational publishing to address these challenges and create products that deliver success in accelerating individual student achievement. The *MyGuide*™ Personal Learning Program offers differentiated instruction based on state standards and student assessment data, utilizing the advances of cognitive science and evidence-based research to focus on the most important skills to drive student achievement. This personalized curriculum designed for use in a group learning context is made possible by two proprietary systems: McGraw Hill's proprietary standards framework (Standards Framework) and McGraw Hill's data analysis algorithm (FPA Algorithm).

Building Blocks: Breaking down standards into their component skills

McGraw-Hill's Standards Framework is a map or network in which each node represents a very specific skill that is a part of a state standard or benchmark. The framework takes standards of varying sizes and weights and breaks them down into skills, allowing the significance of each skill to be more accurately assessed.

The Learning Map: Uncovering how students learn

These component skills are organized within an ordered structure called a learning map, which defines how students are likely to progress through the universe of skills.

For example, one target skill in the framework is *Find the perimeter of a rectangle, given its length and width*. In order to master this skill, a student must have already mastered various precursor skills. One such precursor for this targeted skill is *Measure the length of a given object to the nearest inch or cm*. The relationship of the target skill to postcursor skills (i.e., skills whose mastery is dependent on the target skill) is also defined within the framework. One such postcursor for the target skill is *Find the perimeter of a triangle or rectangle, given all corner points*. This example highlights both the granularity of the skills and the complex web of dependencies defined by McGraw-Hill's Standards Framework; these two features contribute to the effectiveness and uniqueness of the learning map.

Subject matter experts develop the learning map by defining the probable relationships among precursor skills, target skills, and postcursor skills (i.e., the probable order in which learning targets are mastered). There may be multiple paths between two learning targets—and these paths may have different probabilities for different groups of students or subpopulations.

The advantage of McGraw-Hill’s Standards Framework in uncovering the keys to student achievement lies in its ability to determine the cognitive importance for each skill. By analyzing the number of precursor and postcursor skills associated with each targeted skill, as well as the skills actually assessed on state and national tests, those skills with the highest cognitive importance that serve as critical nodes in the progression of knowledge can be highlighted. These relationships help to emphasize the instructional relevance of each skill.

Another key feature of the Standards Framework is its adaptivity. As we learn more about what students know and how they learn through assessment data, this framework is refined to more accurately reflect the learning process necessary to master the critical skills for student achievement of state standards.

Marrying Skills and Assessment Data: Differentiated instruction at a granular level

The final piece of the puzzle involves connecting the framework of skills to the actual knowledge of individual students as represented by assessment scores.

Assessment reports tend to provide each student with an overall performance level, as well as raw scores for each topic or reporting category (e.g., points correct or percent correct). However, the raw scores do not provide meaningful evaluation of scores at the topic level and are often misleading. For example, percent-correct scores may be misinterpreted using a classroom grading scale (e.g., 75% correct is a C), or points- or percent-correct scores may be improperly used to identify relative strengths and weaknesses. These interpretations do not account for the differential difficulty of assessment items or the disparity of points possible in each reporting category. McGraw-Hill solves these problems by providing topic performance levels that describe a student’s instructional need in each topic.

Three topic performance levels, typically derived from overall assessment performance levels, recommend appropriate instructional action in Fundamentals, Practice, or Advanced (FPA) work for each student in each topic. The FPA algorithm is implemented to determine the range of percent

correct (or points correct) scores that falls into each of the following topic performance levels:

- **Level 1: Likely to Need Help with Fundamentals**
This topic performance level is most representative of the performance of students who scored Below Proficient overall.
- **Level 2: Likely to Need Instruction at Grade Level and Practice**
This topic performance level is most representative of the performance of students who scored Proficient overall.
- **Level 3: Likely to Be Ready for Advanced Work**
This topic performance level is most representative of the performance of students who scored Advanced overall.

These topic performance levels highlight the relative strengths and weaknesses of each student. For example, it is possible for a student who performed Below Proficient on the assessment overall to score at Level 1 in some topic areas, but also score at Level 2 or even Level 3 in other topic areas.

These topic performance levels then provide a guide for determining the appropriate instructional materials for each individual student. Within the Standards Framework, the learning map is linked to assessment reporting categories as well as the content of instructional materials, facilitating the delivery of materials targeting the most instructionally relevant skills to students at each topic performance level. The table below demonstrates how the topic performance levels are connected to the skills in the Standards Framework.

FPA Topic Performance Levels	Learning Map Nodes
1: Likely to Need Help with Fundamentals	Precursor Skills
2: Likely to Need Instruction at Grade Level and Practice	Target Skills
3: Likely to Be Ready for Advanced Work	Postcursor Skills

This process results in the production of individualized instructional materials for students—the Grow Network’s *MyGuide* Personal Learning Program. This program facilitates differentiated instruction with a common context for each topic, but leveled exercises and activities to facilitate small-group and individual study to scaffold each student at the appropriate level and to accelerate each student’s achievement.

Bridging Assessment and Instruction

Utilizing the Standards Framework and the FPA Algorithm to produce the *MyGuide* Personal Learning Program transforms assessment results into actionable personalized instructional tools for the classroom. Finally, classroom teachers can function effectively in a group-learning context while meeting each student at the appropriate level, helping each student set goals for achievement and focus on the specific granular skills required to reach those goals.

Because each *MyGuide* progresses through the same topics as the state assessment's reporting categories in the same order, and provides a common context, *MyGuide* can easily be used in a group setting. The Teacher Guide includes teaching strategies, sample lesson plans, and other resources, as well as a Comprehensive *MyGuide* with all the potential content found in the student *MyGuide*. The student's personalized *MyGuide* has content addressing the most instructionally relevant skills for each individual for each topic, depending upon the student's topic performance levels from the assessment data. Some students will find exercises that focus on foundational issues or precursor skills to the target skills required for proficiency. Others will find additional practice for core skills to reinforce their basic aptitude. Finally, students who have demonstrated mastery of the targeted skill will be introduced to postcursor skills that build on their existing foundation and take them to the next level.

The utilization of McGraw-Hill's Standards Framework and FPA Algorithm in the production of the *MyGuide* Personal Learning Program provides significant advantages unmatched by any available alternatives.

→ **Granularity of skills**

McGraw-Hill's Standards Framework illuminates the deeper and more granular skills that build state standards and are foundational for solid learning. Unlike textbooks with alignment maps or test blueprints, which provide only the connections between broad state standards and curriculum topics, this approach offers a richer view of what students need to learn, affording the augmentation of details in assessment reports and providing teachers with strong approaches for group and individual instruction.

→ **Time for learning**

By focusing on the most critical skills with the greatest cognitive importance, the Standards Framework and FPA Algorithm ensure

that class time is spent on formative instruction that both accelerates student achievement on high-stakes assessments and deepens students' underlying knowledge structures of core subjects.

→ **Differentiated instruction and personalized learning**

The Standards Framework and FPA Algorithm afford the production of instructional materials that support a rich group learning context, leveraging existing instructional teams rather than relying on automated or resource-intensive tutoring intervention strategies for individual students. At the same time, each individual student is focused on personalized goals and paths for future achievement based on specific skills determined by their past performance.

Conclusion

McGraw-Hill's Standards Framework makes sense of the complicated universe of diverse state standards and the skills necessary for student achievement. By breaking down standards into their component skills and mapping the probabilistic relationships among them, cognitively important skills for student learning are highlighted. Vetted by experts and an ever-increasing body of assessment data, these learning maps become the foundation for targeting personalized instruction to the skills most needed to accelerate student achievement. At the same time, McGraw-Hill's FPA Algorithm takes misleading raw scores on assessment reports and transforms them into actionable data that identifies appropriate topic performance levels, facilitating the delivery of personalized content at a granular level to each student. The Grow Network utilizes these proprietary technologies together in order to deliver easy-to-use instructional solutions, providing an unparalleled opportunity for schools to meet the challenges posed by high-stakes assessments and the pursuit of individual student achievement.



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